Early Level 1b evaluation based on HIRS experience

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Current Tasks

- Main Efforts Since Last Meeting
  - Supplement radiosonde information to complete a profile
    - This means adding the unknown data – not data from other truth
  - Put the team match files in our data base
    - We are doing a match but want the official team version
- Radiosonde Match System
  - Status - running
  - Running from Mitch's data
    - Now adding retrievals
  - Matching HIRS data and AIRS data

Current Tasks Continued

- Use of GPS data
  - Place data in match files with closely collocated radiosondes
  - Format is set but no data yet
  - Like to get more than 10 (15) US matches
  - Compare total water vapor and
    - Adjust the radiosonde or
    - Reject it
- We will place other data in our match file
  - The sooner we can details about a format, the better
  - Might be useful to look at our format on our web site

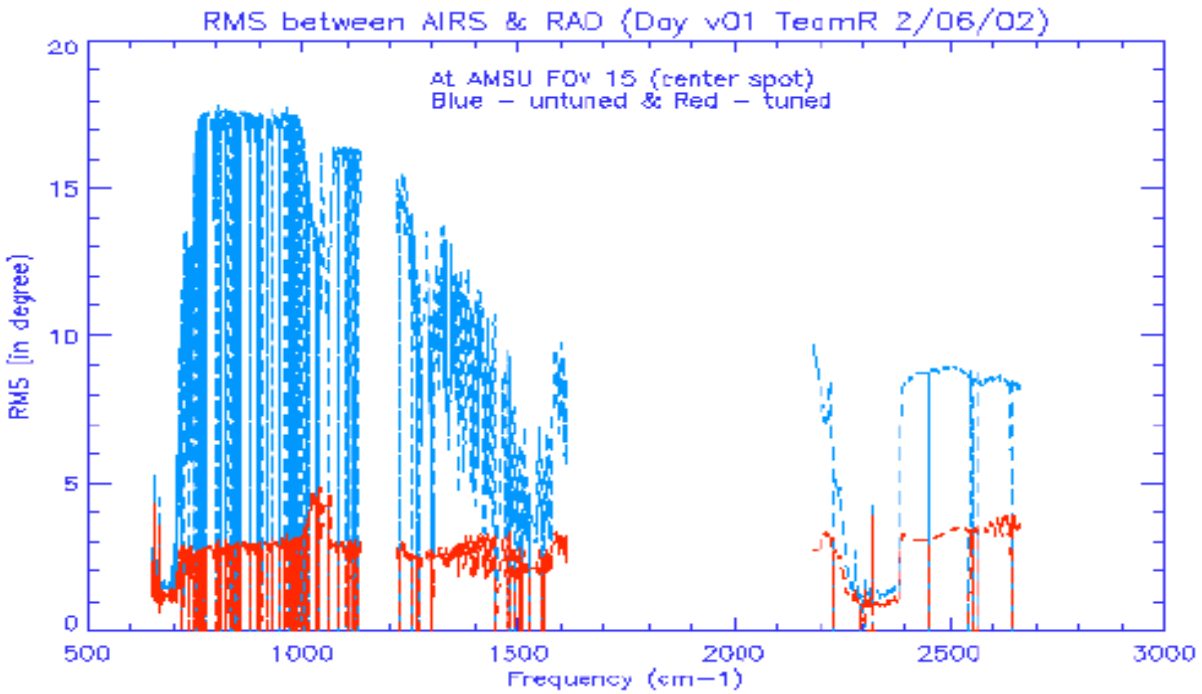
Early Validation for AIRS

- Capabilities on NESDIS match files
  - Current
    - Radiosondes - initial and final versions
      - Upper water vapor now present
    - Hourly surface observations
    - ACARS/ARINC
    - Buoys
    - NCEP forecast
  - Available but not implemented
    - GPS
    - Ozone
    - ARM/CART
    - Other validation data

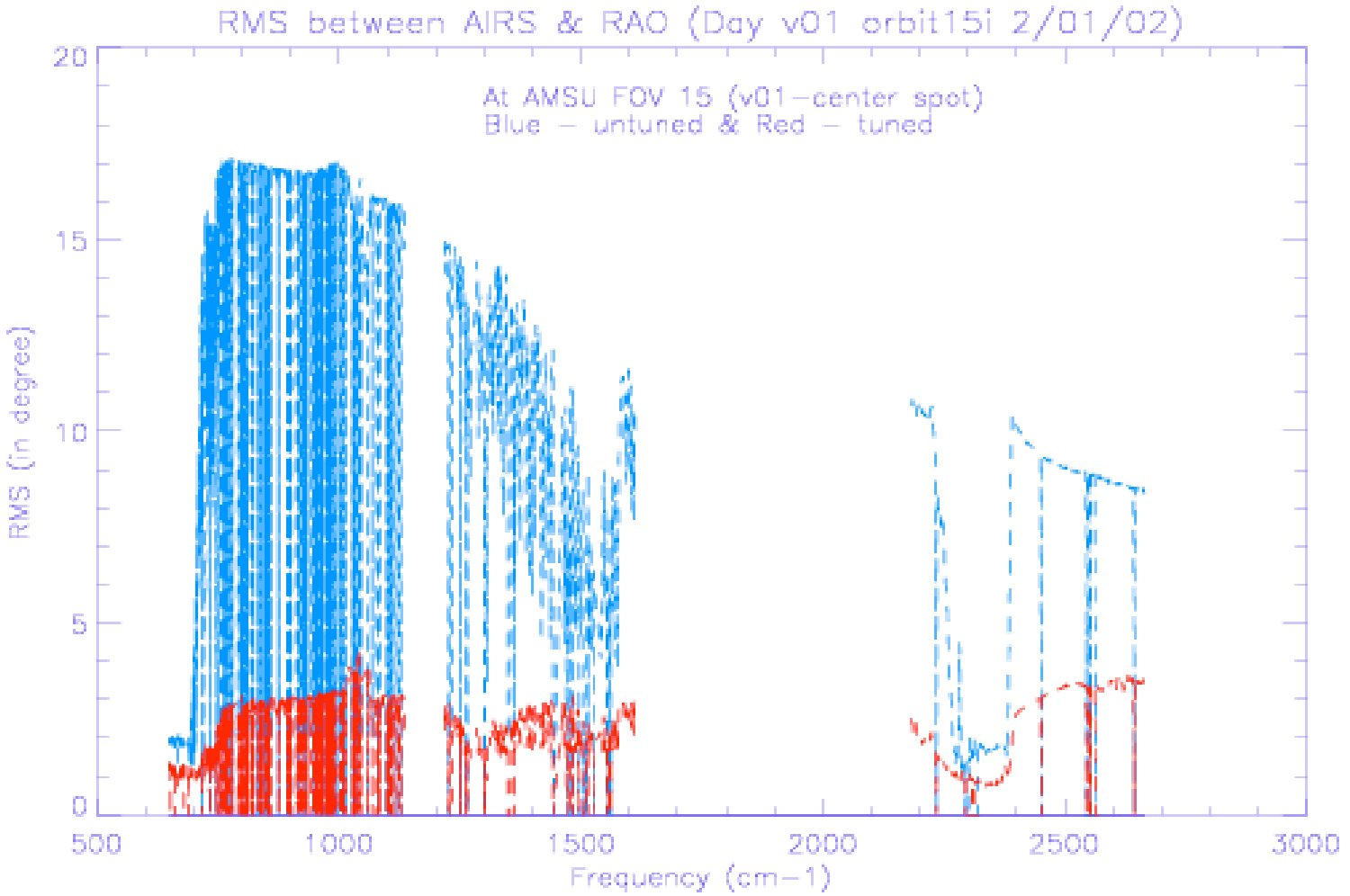
Early Validation for AIRS

- Radiance Adjustments have been tested in many configurations
  - Scientific Simulations - Reduces Errors to noise levels
  - System simulations - Sample is not sufficient for science
    - Approach – relax the threshold and accept cloudy
    - Allows data flow to be tested
  - Complete the radiosonde
    - Use team retrieval - test the full system
    - Use regression - stable
    - Use forecast - causes a bias if used with radiosondes as truth

Tuning test with cloudy data – team retrieval used to complete the radiosonde



Tuning Test with cloudy data - Regression Retrieval used to complete the radiosonde



Early Validation for AIRS

- Data Sources
  - AIRS granules - pull data and convert - 1 week online
    - Capability - start routine runs
  - AIRS matches - pull data and put into NESDIS match system
    - Capability - start routine runs - several months (6) online
  - Mitch's gridded data
  - NCEP forecast
  - Complete state specification - complete the radiosonde
    - Team retrieval
    - Regression retrieval
    - forecast
  - ECMWF forecast ?????

Early Validation for AIRS

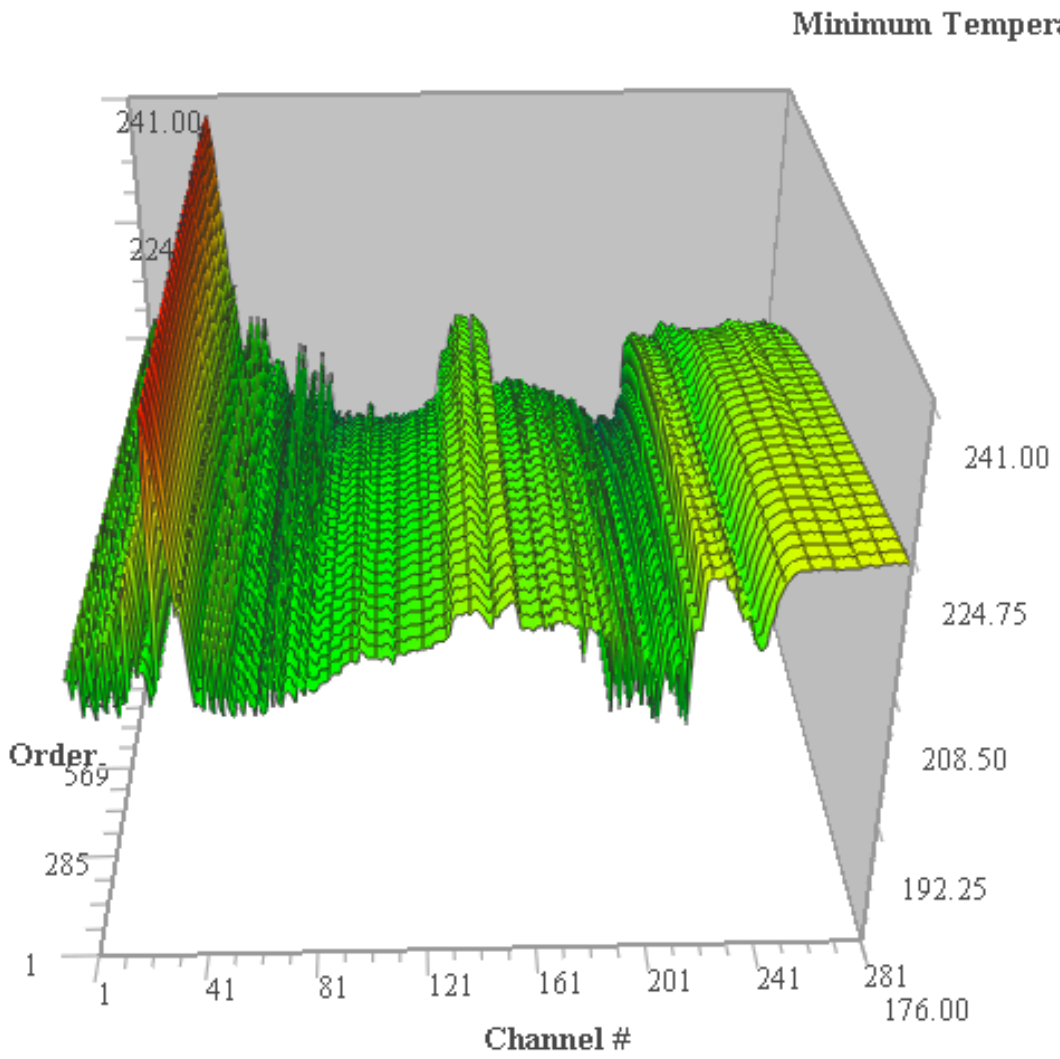
- Early tests
  - Extremes test
  - Tuning test
  - Mirror coating test
  - Covariance test – Eigenvector test
  - Scan bias test
  - Noise test
  - Sun Glint test
  - Spectral stability test

Early Evaluations

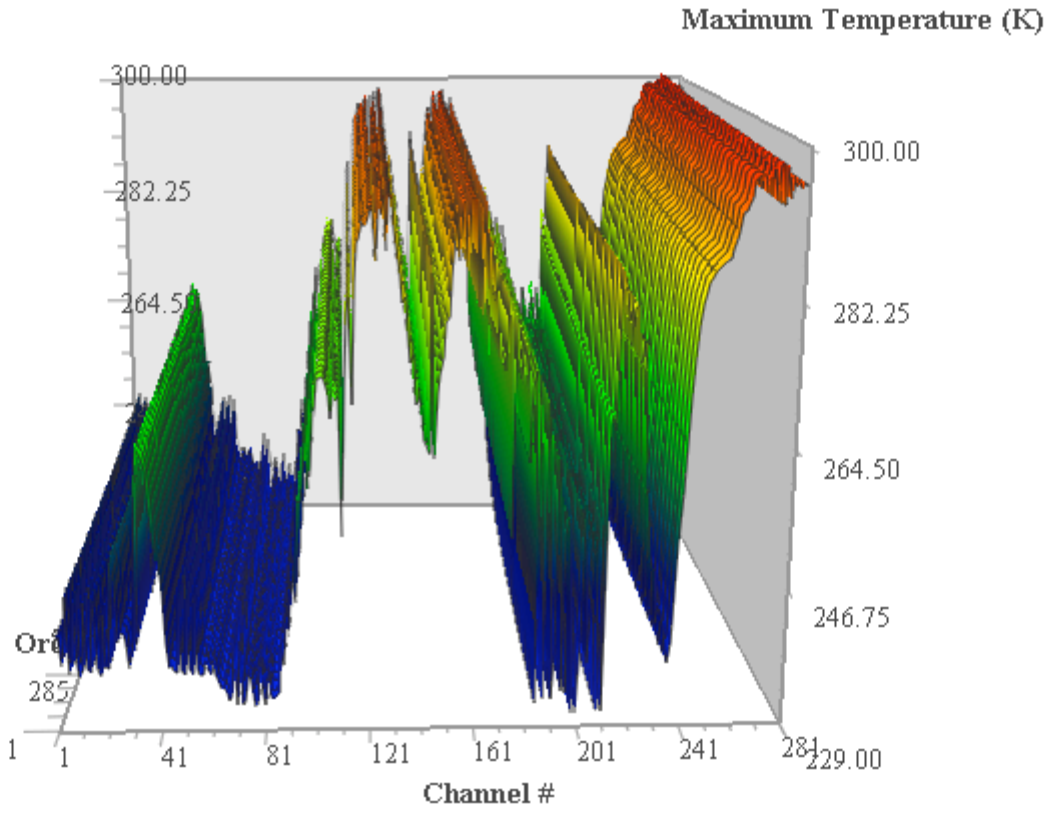
- Extremes test
  - Purpose - Look for drifts in the data with time
  - Average the warmest 2% of observations and track with time
  - Average the coldest 2% of observations and track with time

- Tuning test
  - Purpose - Get an early look at tuning performance
  - Perform early tuning based on differences from NCEP model
  - Track with time stability
  - Compare with RAOB values when a sample is available
  - Compare tunings based on NCEP and ECMWF values

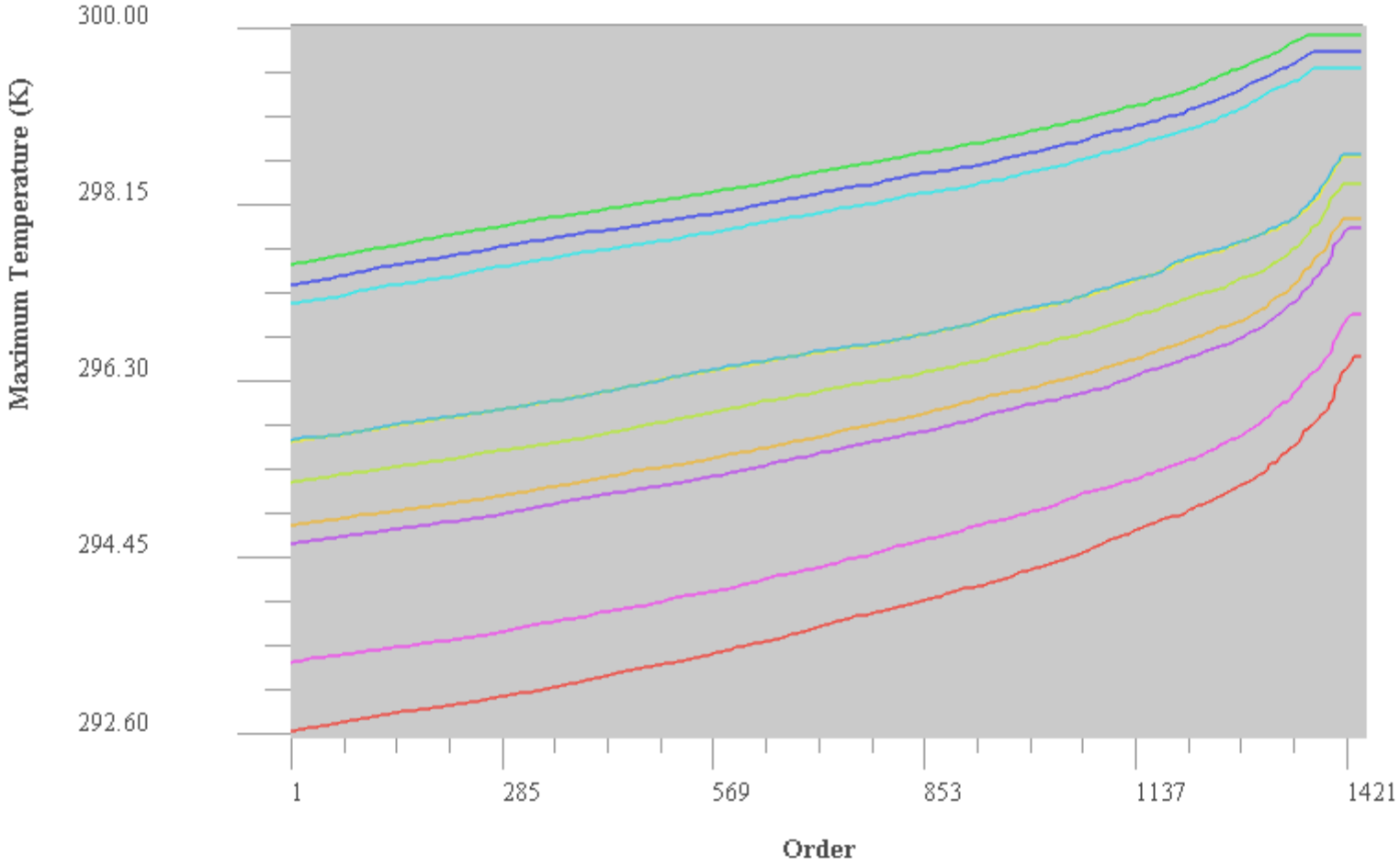
Minimum temperatures for sounding channels



Maximum temperatures (K) for sounding channels



Maximum temperature (K) for shortwave channels



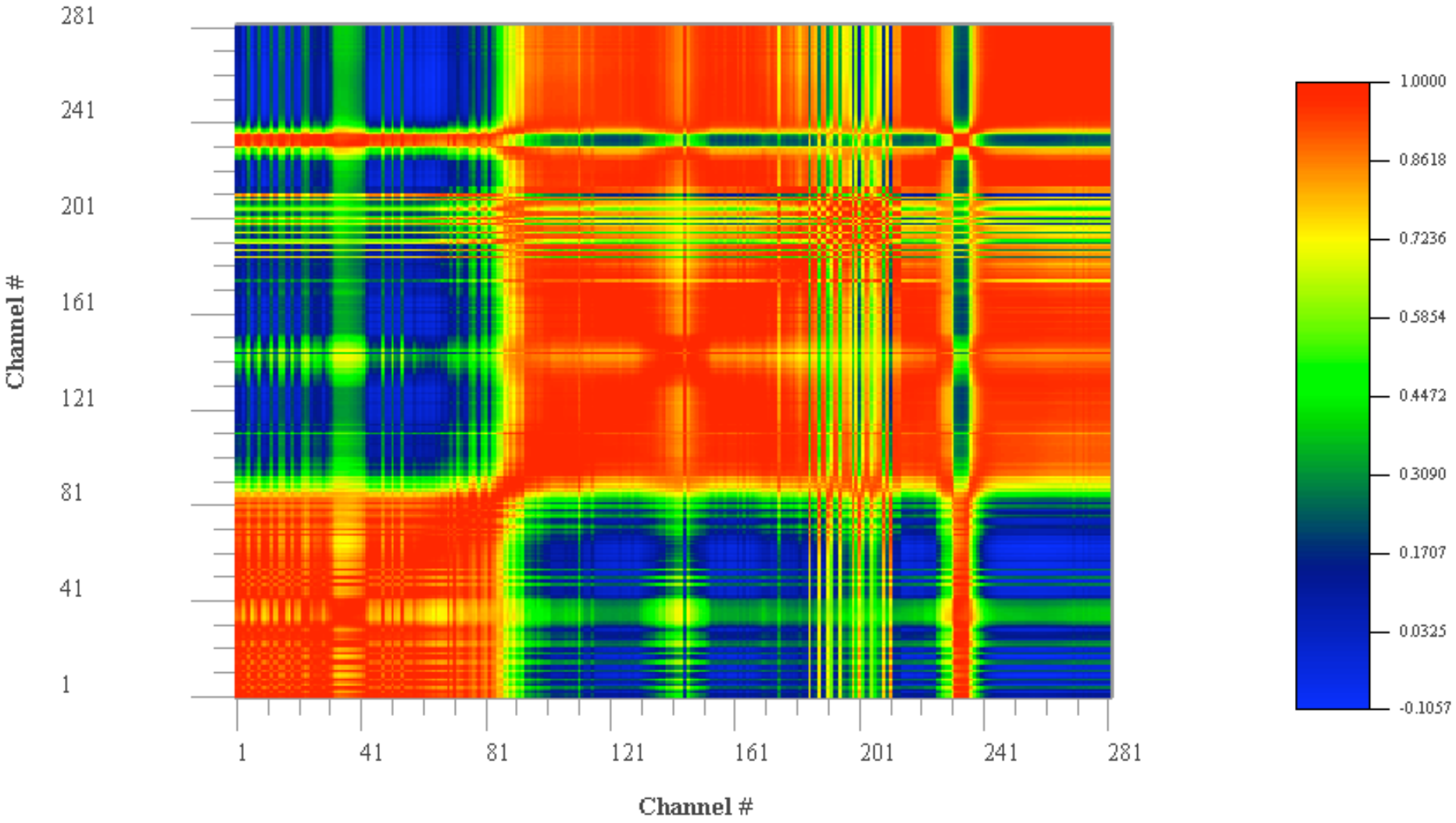
Early Evaluations Continued

- Mirror Coating Test
  - Purpose – Look for angle dependent problems caused by coatings
    - Scan mirror coatings polarizes the signal and rotates relative to the instrument
  - Cold clouds can reveal a scan bias caused by a mirror coating
  - All but the most opaque channels see the same temperature
  - Select areas with low temperatures, 210 (ie. High clouds)
  - Calculate the expected value by averaging unaffected channels
    - Coldest values are the least affected – mirror is warmer
  - Plot the channel difference from the average of unaffected channels
  - Look at deviations as a function of scan position
  - Calculate eigenvectors of the differences
  - If patterns exist
    - Use the measured mirror temperature to calculate emissivities

Early Evaluations Continued

- Covariance Test
  - Purpose – look for systematic differences between calculated & observed
  - The Covariances of measured and calculated radiances should agree
  - Select clear areas and calculate the covariance of the measured radiances
  - Using the forecast values, calculate radiances and then the covariance
  - Difference the covariances and display the result
  - If differences occur, investigate the cause
- Eigenvector Test – Equivalent
  - Calculate eigenvectors from clear data
  - Use to dominant ones to calculate PCS's from measured data
  - Multiply by the eigenvectors to reconstruct the measurements
  - Difference the measured and reconstructed values
  - Map the differences for channels with large departures

Correlation Matrix for Observed BT's



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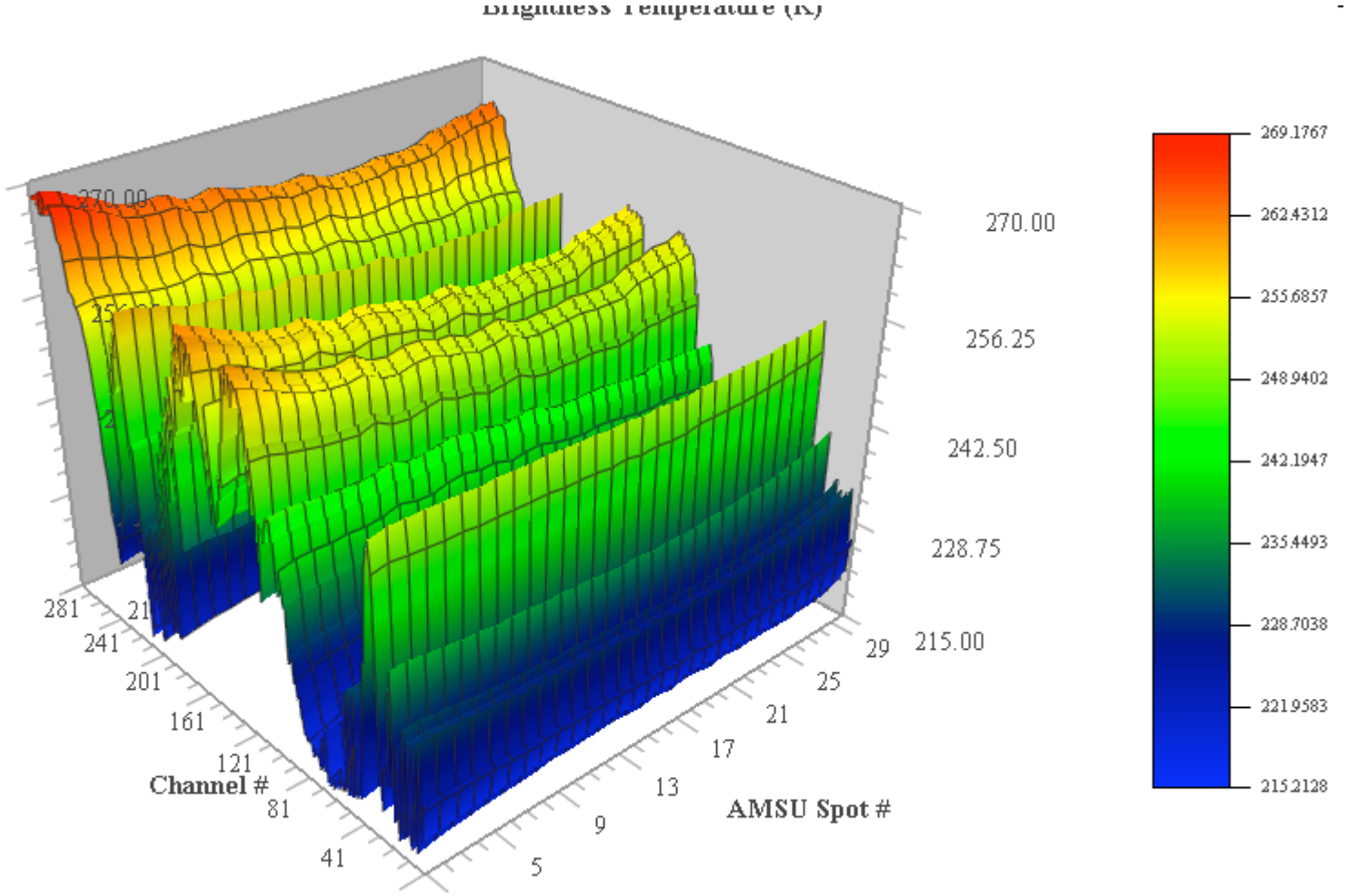
Early Evaluations Continued

- Scan Bias Test
  - Purpose – look for scan dependent biases
  - Select clear observations
  - Calculate radiances from the forecast/analysis using bias adjustment
  - Calculate radiances from the forecast/analysis without the bias adjustment
  - Difference the measured and clear values
  - Map the differences for each scan angle
  - Average over latitude bands and the globe for each scan angle
  - Compare the results
- Noise Test
  - Purpose – Establish the noise level in orbit
  - Compare adjacent clear spots to get the noise
  - Subtract along track values and cross track values separately
  - Calculate the mean and rms to get noise values
    - Note – along track mean should be zero

Average Temperatures (K) with scan angle and Channel



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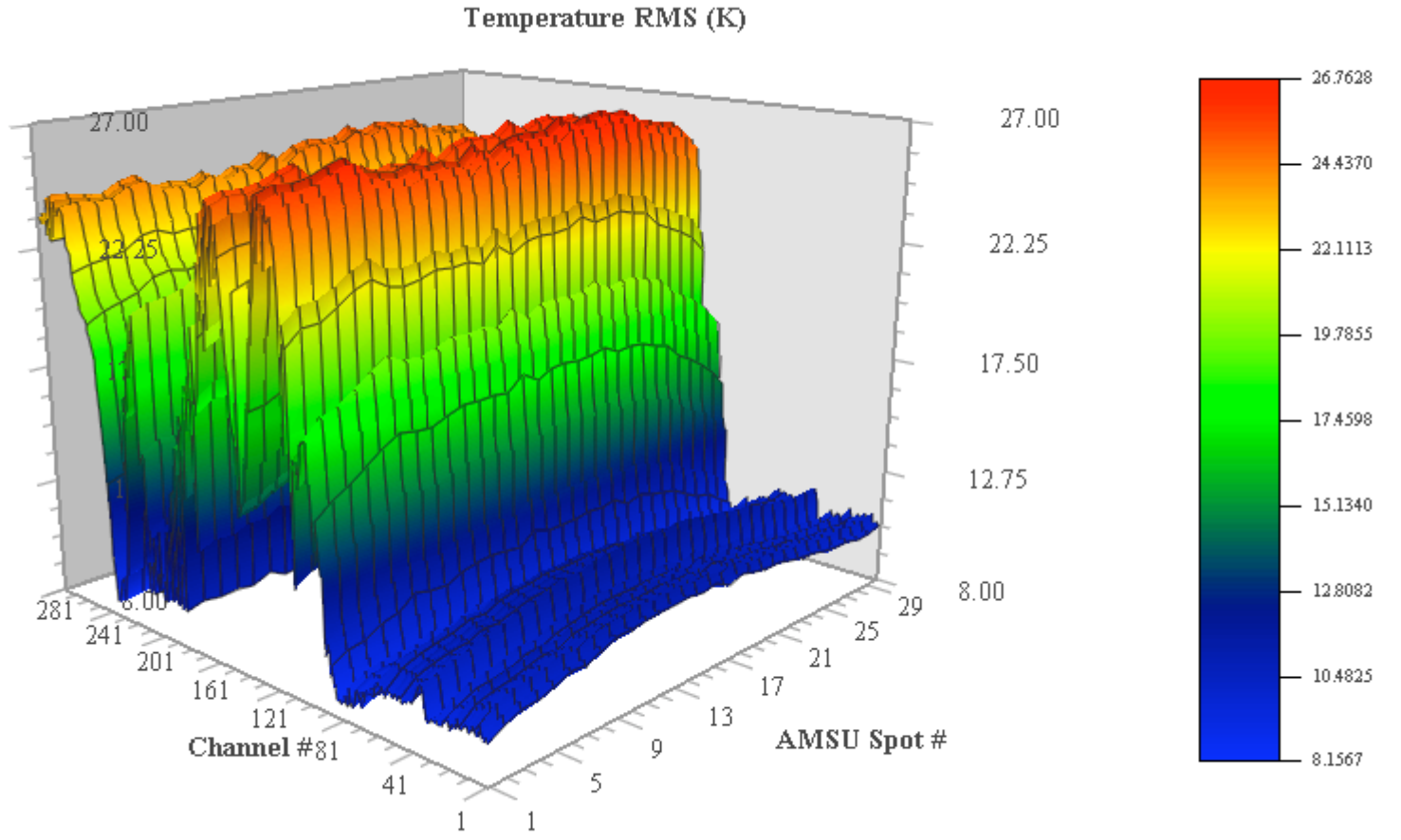
RMS Temperature (K) with scan angle and channel



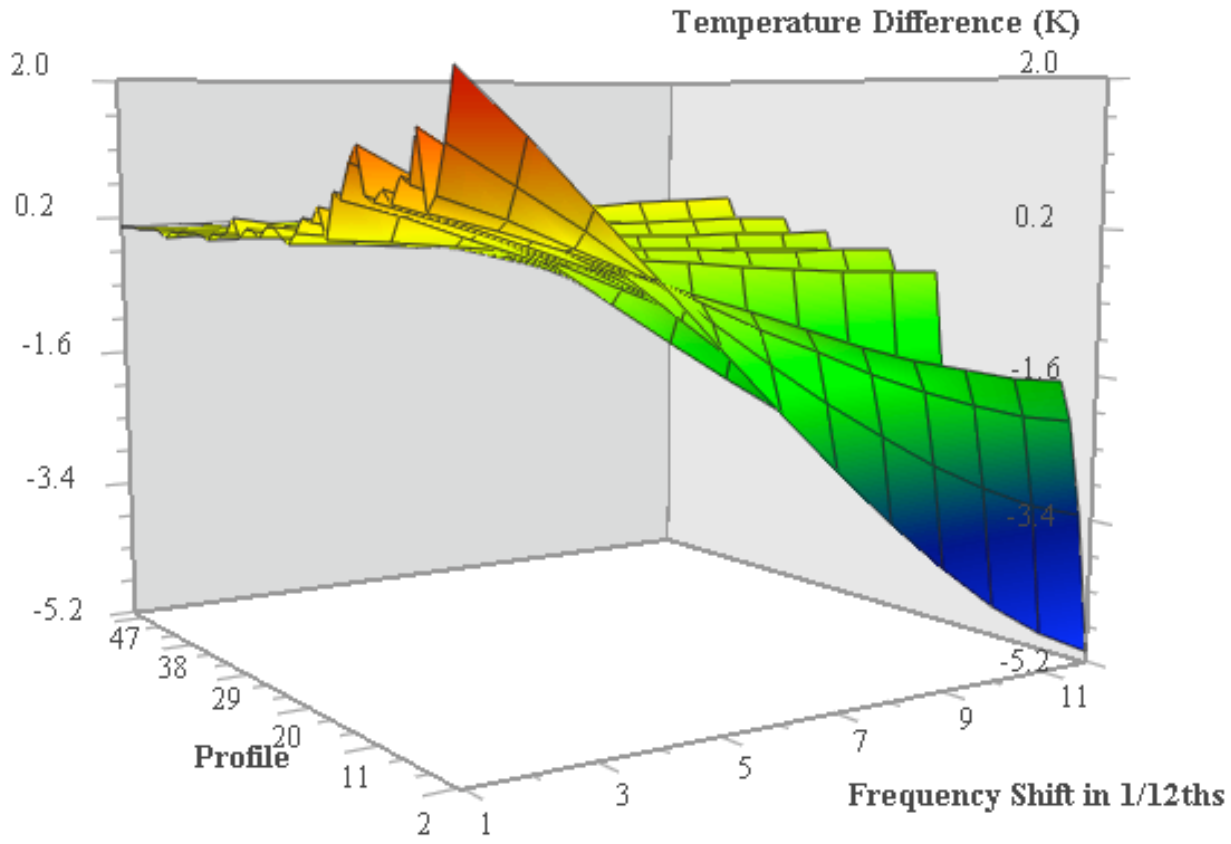
Early evaluations Continued

- Sun Glint Test
  - Purpose - Establish the angles & channels affected by reflected solar radiation
  - Use clear data at night (SZA>96) to create coefficients to predict shortwave channels from longwave channels
  - Apply the coefficients to nighttime data over oceans to establish the error level
  - Apply the coefficients to daytime data over oceans to get solar effects
  - Plot a typical orbit to get the expected value
- Step 2
  - Get the forecast wind speed
  - Plot the difference as a function of wind speed
  - Do the same for land except for the wind speed

Early evaluations Continued

- Spectral stability Test
  - Purpose – detect shifts in frequency
  - Select pairs of channels that are on opposite sides of a spectral line and have about the same radiance – one pair for each module
  - Calculate the expected temperature difference over a tropical atmosphere
  - Use clear data (not necessary for high peaking channels) to calculate the difference
  - Compare the expected and measured values
  - Plot the difference as a function of time
  - Alternative
    - Calculate principal component scores for measured and calculated values
    - Look at the differences

Channel Pair Temperature Difference (K) with Frequency Shift – profiles are ranked by surface temperature



Early Validation for AIRS

- Early tests
  - Extremes test — done
  - Tuning test — done
  - Mirror coating test — done but no simulated test data
  - Covariance test – Eigenvector test — done
  - Scan bias test — need real data
  - Noise test — need real data
  - Sun Glint test — done but no simulated test data
  - Spectral stability test — have channels selected

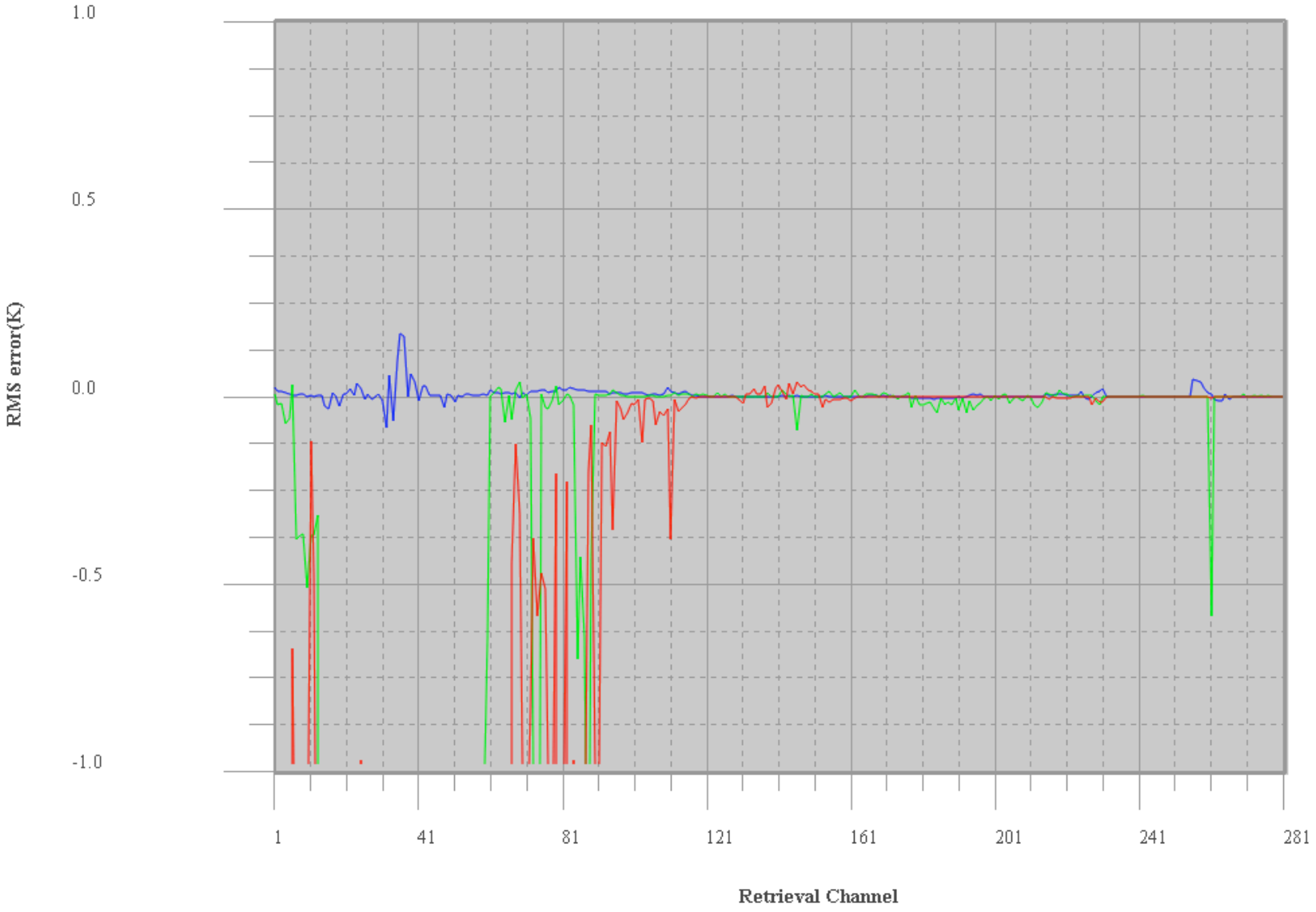
OPTRAN coefficients

- Generate coefficients for AIRS use by NCEP
  - Two runs have been made
    - Tom Kleespies - will be shown
      - Normal OPTRAN
    - Yoshihiko Tahara - talk later?
      - Reduced number of coefficients via vertical polynomial expansion
  - Kleespies
    - Numerical issues at some wavelengths - have been handled before
  - Yoshihiko
    - Numerical issues solved
- Other issues
  - Need a good set of profiles
    - 32 does not have full representation
    - 48 does not have a level profile
    - ECMWF is awkward – different set of profiles for ozone

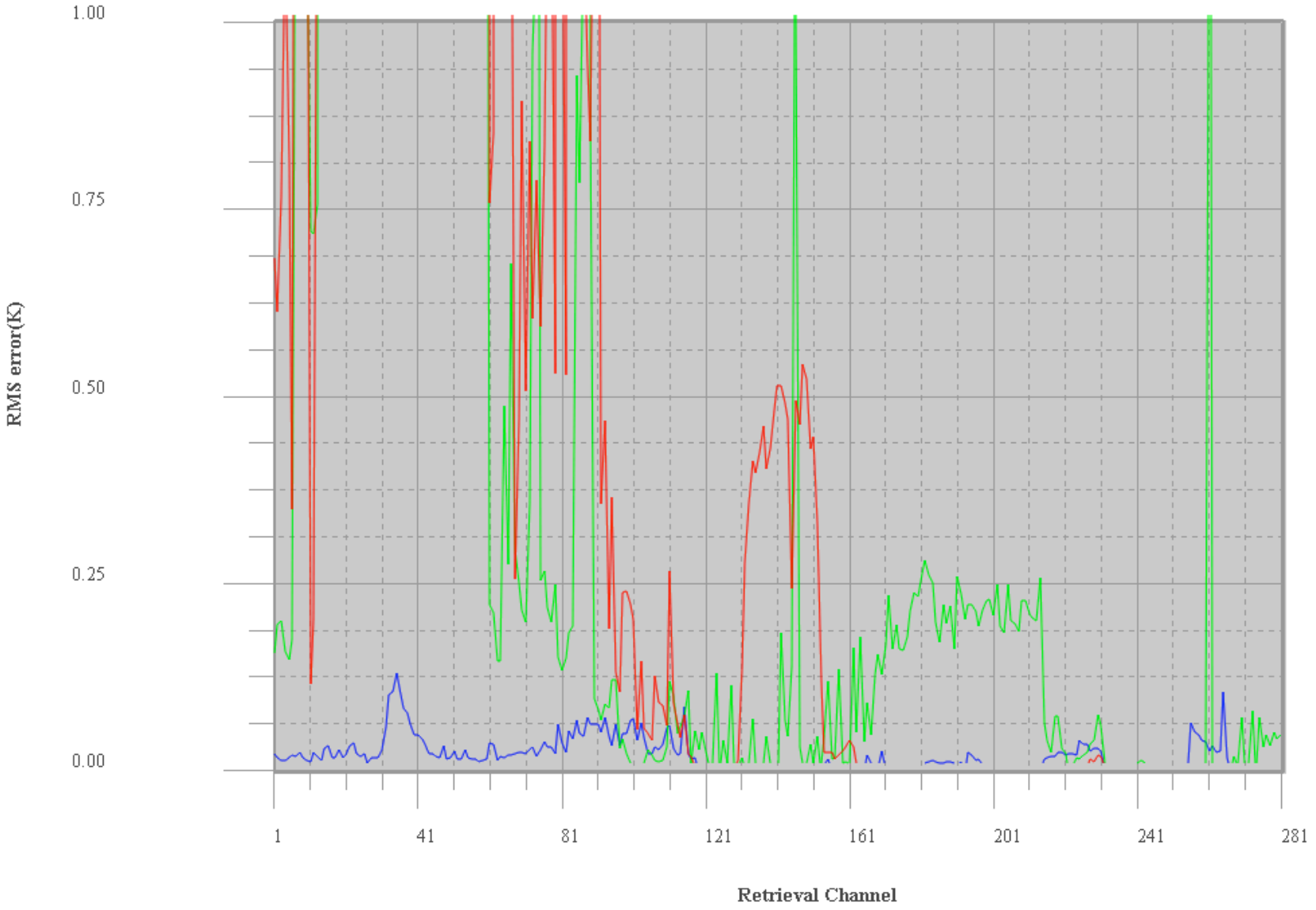
OPTRAN coefficients

- Other issues
  - Line-by_line or equivalent
    - kCARTA
      - Better results for most channels
      - Currently an issue for channels 3-5 with real HIRS data
      - May be due to something other than kCARTA
      - Is being investigated
    - Alternative LBLRTM
  - Safe approach is LBLRTM with 32 profiles
  - Would really like 48 profile set with level profiles

Average error (K) as a function of channel



RMS Error (K) as a function of Channel



Validation Plans

- A trial version is set up on a website
- Orbit-net.nesdis.noaa.gov/crad/ipo
- Capabilities
  - View matches with AIRS and HIRS
  - View ACARS reports
  - View monthly statistics TOVS up through NOAA 14
  - View data as a function of time, angle etc.
  - View the HDF format specification